CHANGES IN TIME AND SPACE: COASTAL LAGOONS

Mindaugas Žilius

We and the environment around us are made up of atoms that combine to form molecules, which in turn form matter. Just imagine how atoms and molecules amalgamate into sand dunes and lagoons, the wooden houses along the shore painted *Nida Blue*, and the yachts that pass them by from time to time. This is how the idyllic image of transit coastal waters, or lagoons, appears in our imagination. Let us ask ourselves: how much do we know about them, and are they changing in space and over time?

From a bird's eye view, we can see that this is a space where the river meets the sea, flowing uninterrupted through a narrow strait. At some point, the river used to flow directly into the sea, but over time, the sand particles it carried formed a spit, separating the delta from the sea and creating coastal lagoons. Lagoons are rare and account for only about 2% of all coastal systems in the Baltic Sea. Nevertheless, their average surface area is one of the largest among all coastal systems. Situated between land and sea, they play an important role in purifying river water before it enters the sea. The micro- and macroorganisms inhabiting the lagoons transform the compounds brought in by the rivers, sometimes even removing them from the ecosystem altogether. However, this role is not as constant as we might imagine. It varies depending on the river's output, the composition and activity of micro- and macroorganisms, and the intensity of the sun.

The Curonian Lagoon is one of the largest lagoons in the Baltic Sea region and Europe as a whole, covering an area of around 1,600 square kilometres. It is a shallow system (with an average depth of 3.8m) where seasonal variations affect conditions such as nutrient availability, which ranges from surplus to deficiency, microorganism diversity, and the availability of light in the water column. One of the factors affecting changes in the Curonian Lagoon is the river Nemunas. It is its largest tributary, bringing in up to 96% of all freshwater. Like all temperate rivers, the flow of the Nemunas is characterised by seasonal variations determined by the amount of inland precipitation or snowmelt. As a result, most of the water entering the lagoon from the Nemunas is discharged during the winter and spring.

The water also carries large quantities of nutrients. However, the composition of the nutrient mix in the river water is much more important than its total volume. How the lagoon changes each time depends on the composition of this nutrient mix. Normally, in spring, when there is an excess of nitrogen and silicon compounds in the river water, intricately-shaped microscopic photosynthetic organisms with protective silicon shells known as diatom algae become the dominant species. Their intensive reproduction and the river's declining flow towards summer usually cause nitrogen and silicon deficiencies, which in turn lead to an increase in opportunistic cyanobacteria, which not only change the colour of the lagoon's water, but also affect the functioning of the whole ecosystem. This disturbs the lagoon's ability to purify the river water, while at the same time, the accumulation of cyanobacteria on the water surface restricts the penetration of light into the deeper strata. As a result, most of the water column remains in complete darkness, while oxygen is rapidly consumed by respiring microorganisms. Under certain circumstances, the bloom of cyanobacteria can often lead to an oxygen deficiency, which is disastrous for many micro- and macroorganisms. Many of us have seen these changes in the lagoon reflected in images of cyanobacteria biomass accumulations and putrid dead fish in the harbours and along the lagoon shores. Does this mean that changes are taking place in the lagoon? Yes.

Viewed through a scientific lens, transit lagoons appear to be in a constant state of transmutation. Many of these changes are invisible to the naked eye because they take place at a molecular or genetic level. We can only imagine how one compound becomes another. For instance, carbon dioxide is absorbed from the atmosphere and turns into matter, i.e., the bodies of microorganisms, to be released again when they die. Although we can often observe cyclical transmutations in lagoons, human activities bring about other transformations that disrupt the recurring processes temporally or spatially. This leads to directional changes, turning the lagoons into a consolidated, damaged, eutrophicated body of water than can hardly recover.